
Appendix B

Glossary

absorbed dose - Energy absorbed per unit mass from any kind of ionizing radiation in any kind of matter.

activation product - Material made radioactive by exposure to radiation from a source such as a nuclear reactor's neutrons.

air submersion dose - Radiation dose received from external exposure to radioactive materials present in the surrounding atmosphere.

alpha radiation - Least penetrating type of radiation. Alpha radiation can be stopped by a sheet of paper or the outer dead layer of skin, and can cause biological damage only if sufficient quantities are emitted inside the body.

aquifer - Permeable geologic unit that can hold and/or transmit significant quantities of water.

background radiation - Radiation in the natural environment, including cosmic rays from space and radiation from naturally occurring radioactive elements in the air, in the earth, and in our bodies. In the United States, the average person receives approximately 300 millirems (mrem) of background radiation per year.

bank storage - Hydrologic term that describes river water that flows into and is retained in permeable stream banks during periods of high river stage. Flow is reversed during periods of low river stage.

becquerel (Bq) - Unit of activity equal to one nuclear transformation per second ($1 \text{ Bq} = 1/\text{s}$). The conventional unit of activity, the curie, is related to the becquerel according to $1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq}$.

beta radiation - One form of radiation emitted from a nucleus during radioactive decay. Beta radiation can be stopped by an inch of wood or a thin sheet of aluminum, and may cause biological damage if a sufficient amount is internal, or occasionally external, to the body.

boundary dose rate - Dose rate measured or calculated at publicly accessible locations on or near the Hanford Site.

collective effective dose equivalent - Sum of the effective dose equivalents for individuals composing a defined population. The units for this are "person-rem" or "person-sievert."

committed dose equivalent - Total dose equivalent accumulated in an organ or tissue in the 50 years following a single intake of radioactive materials into the body.

composite sample - Sample formed by mixing discrete samples taken at different times or from different locations.

confined aquifer - An aquifer bounded above and below by less-permeable layers. Groundwater in the confined aquifer is under a pressure greater than atmospheric pressure.

continuous sample - Sample formed by the continuous collection of the medium or contaminants within the medium during the entire sample period.

controlled area - An area to which access is controlled to protect individuals from exposure to radiation or radioactive and/or hazardous materials.

cosmic radiation - High-energy subatomic particles and electromagnetic radiation from outer space that bombard the earth. Cosmic radiation is part of natural background radiation.

curie (Ci) - A unit of radioactivity equal to 37 billion (3.7×10^{10}) nuclear transformations per second.

decay - The decrease in the amount of any radioactive material with the passage of time, as a result of the spontaneous emission from the atomic nuclei of nucleons or either alpha or beta particles, often accompanied by gamma

radiation. When a radioactive material decays, the material may be converted to another radioactive species (decay product) or to a nonradioactive material.

derived concentration guides (DCG) - Concentrations of radionuclides in air and water that an individual could continuously consume, inhale, or be immersed in at average annual rates, and not receive an effective dose equivalent of greater than 100 mrem/yr.

detection level - Minimum amount of a substance that can be measured with a 99% confidence that the analytical result is greater than zero.

dispersion - Process whereby effluents are spread or mixed as they are transported by groundwater or air.

dose equivalent - Product of the absorbed dose, the quality factor, and any other modifying factors. The dose equivalent is a quantity for comparing the biological effectiveness of different kinds of radiation on a common scale. The unit of dose equivalent is the rem. A millirem is one one-thousandth of a rem.

dosimeter - Portable device for measuring the total accumulated exposure or absorbed dose from ionizing radiation fields.

effective dose - See “effective dose equivalent.”

effective dose equivalent - A value used for estimating the total risk of potential health effects from radiation exposure. This estimate is the sum of the committed effective dose equivalent (see above) from internal deposition of radionuclides in the body and the effective dose equivalent from external radiation received during a year.

effluent - Liquid or gaseous waste streams released from a facility.

effluent monitoring - Sampling or measuring specific liquid or gaseous effluent streams for the presence of pollutants.

exposure - The interaction of an organism with a physical agent (e.g., radiation) or a chemical agent (e.g., arsenic) of interest. Also used as a term for quantifying x and gamma radiation fields (see “roentgen”).

external radiation - Radiation originating from a source outside the body.

fallout - Radioactive materials that are released into the earth’s atmosphere following a nuclear explosion or atmospheric release and that eventually fall to earth.

fission - A nuclear reaction involving the splitting or breaking apart of a nucleus into at least two other nuclei, accompanied with a release of various types of energy. For example, when a heavy atom such as uranium is split, large amounts of energy including radiation and neutrons are released along with the new nuclei (which are fission products).

fission products - Elements formed from fissioning. Many fission products are radioactive.

gamma radiation - Form of electromagnetic, high-energy radiation emitted from a nucleus. They require heavy shielding, such as concrete or steel, to be stopped, and may cause biological damage when originating internally or externally to the body in sufficient amounts.

grab sample - A sample that is randomly collected or “grabbed” from the collection site.

groundwater - Subsurface water that is in the pore spaces of soil and geologic units.

gray (Gy) - Unit of absorbed dose in the International System of Units (SI) equal to 1 joule per kilogram. 1 Gy = 100 rad.

half-life - Length of time in which a radioactive substance will lose one half of its radioactivity by decay. Half-lives range from a fraction of a second to billions of years, and each radionuclide has a unique half-life.

internal radiation - Radiation originating from a source within the body as a result of the inhalation, ingestion, skin absorption, or implantation of natural or manmade radionuclides in body tissues (e.g., uranium dust in the lungs, radioiodine in the thyroid).

ion exchange - The reversible exchange of one species of ion for a different species of ion within a medium.

irradiation - Exposure to radiation.

isotopes - Different forms of the same chemical element that are distinguished by different numbers of neutrons in the nucleus. A single element may have many isotopes; some may be radioactive and some may be nonradioactive (stable). For example, the three isotopes of hydrogen are protium, deuterium, and tritium.

long-lived radioisotope - A radionuclide that decays at such a slow rate that a quantity will exist for an extended period (typically many years).

maximally exposed individual - A hypothetical member of the public residing near the Hanford Site who, by virtue of location and living habits, could receive the highest possible radiation dose from radioactive effluents released from Hanford.

mean - Average value of a series of measurements. The mean, \bar{X} , was computed as:

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$$

where X_i is the i th measurement and n is the number of measurements.

median - Middle value in a set of results when the data are ranked in increasing or decreasing order.

millirem (mrem) - A unit of radiation dose equivalent that is equal to one one-thousandth (1/1000) of a rem. According to DOE standards, an individual member of the public may receive no more than 100 mrem per year from a site's operation. This limit does not include radiation received for medical treatment or the approximately 300 mrem that people receive annually from natural background radiation.

minimum detectable concentration - Smallest amount or concentration of a radioactive or nonradioactive element that can be reliably detected in a sample.

noble gas - Any of a group of chemically and biologically inert gases that includes argon, krypton, and xenon. These gases are not retained in the body following inhalation. The principal exposure pathways for radioactive noble gases are direct external dose from the surrounding air (see "air submersion dose").

offsite locations - Sampling and measurement locations outside the Hanford Site boundary.

onsite locations - Sampling and measurement locations within the Hanford Site boundary.

operable unit - A discrete area for which an incremental step can be taken toward comprehensively addressing site problems. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site.

outfall - End of a drain or pipe that carries waste water or other effluents into a ditch, pond, or river.

plume - The cloud of a pollutant in air, surface water, or groundwater formed after the pollutant is released from a source.

plutonium - A heavy, radioactive, manmade metallic element consisting of several isotopes. One important isotope is ^{239}Pu , which is produced by the irradiation of ^{238}U . Routine analysis cannot distinguish between the ^{239}Pu and ^{240}Pu isotopes; hence, the term $^{239,240}\text{Pu}$ as used in this report is symbolic of the presence of one or both of these isotopes in the analytical results.

quality assurance - Actions that provide confidence that an item or process meets or exceeds that user's requirements and expectations.

quality control - Comprises all those actions necessary to control and verify the features and characteristics of a material, process, product, or service to specified requirements. Quality control is an element of quality assurance.

rad - The basic unit of absorbed dose of radiation.

radiation - The energy emitted in the form of rays or particles such as those thrown off by transforming (disintegrating) atoms. For this report, radiation refers to ionizing types of radiation; not radiowaves, microwaves, radiant light, or other types of nonionizing radiation. The ionizing rays or particles typically consist of alpha, beta, or gamma radiation.

radioactivity - Property possessed by some isotopes of elements of emitting radiation (such as alpha, beta, or gamma rays) spontaneously in their decay process to stable element isotopes.

radioisotope - Virtually synonymous with radionuclide.

radionuclide - A species of atoms having a particular number of protons (Z), a particular number of neutrons (A), and a particular atomic weight ($N = Z + A$) that happens to emit radiation. Carbon-14 is a radionuclide. Carbon-12 is not and is called just a "nuclide."

rem - A unit of dose equivalent and effective dose equivalent.

risk - The probability that a detrimental health effect will occur.

roentgen (R) - Unit of x ray or gamma photon exposure measured in air, historically used to describe external radiation levels. An exposure of one roentgen typically causes an effective dose of one rem.

short-lived radioisotope - A radionuclide that decays so rapidly that a given quantity is transformed almost completely into decay products within a short period (typically less than a few months).

sievert (Sv) - Unit of dose equivalent and effective dose equivalent in the International System of Units (SI) equal to 100 rem.

spent fuel - Uranium metal or oxide and its metal container that have been used to power a nuclear reactor. It is highly radioactive and typically contains fission products, plutonium, and residual uranium.

standard deviation - An indication of the dispersion or variability of a set of results around their average.

standard error of the mean - A measure of the precision of a mean of observed values; that is, an estimate of how close a mean of observed values is expected to be to the true mean. The standard error of the mean is computed as

$$SE = \sqrt{\frac{S^2}{n}}$$

where S^2 , the variance of the n measurements, was computed as

$$S_M^2 = \frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2$$

This estimator, S^2 , includes the variance among the samples and the counting variance. The estimated S^2 may occasionally be less than the average counting variance.

transuranic - An element with an atomic number greater than 92 (92 is the atomic number of uranium).

thermoluminescent dosimeter - A device containing a material that, after being exposed to beta and/or gamma radiation, emits light when processed and heated. The amount of light emitted is proportional to the absorbed dose to the thermoluminescent dosimeter.

unconfined aquifer - An aquifer containing groundwater that is not confined above by relatively impermeable rocks. The pressure at the top of the unconfined aquifer is equal to that of the atmosphere. At Hanford, the unconfined aquifer is the uppermost aquifer and is most susceptible to contamination from site operations.

uncontrolled area - Area on or near a nuclear facility to which public access is not restricted.

vadose zone - Underground area from the surface to the top of the water table or aquifer.

water table - Theoretical surface represented by the elevation of water surfaces in wells penetrating only a short distance into the unconfined aquifer.

wind rose - Star-shaped diagram showing how often winds of various speeds blow from different directions, usually based on yearly averages.